Open Access
J. Food Proc. & Nutr. Res., 2025, 2(1):29-38
ISSN (Online): 3078-9133; ISSN (Print):3078-9125
DOI: https://doi.org/10.22194/ JFPNR /25.1020
https://societyfia.org/journal/JFPNR

Hypolipidemic Effects of Mango (*Mangifera indica*) Pulp, Peel and Kernel: A Review

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Hyperlipidemia is a general term that is associated with elevated levels of lipids in the body. It can increase the risk of CVDs which is the widely spread cause of death all over the world. Unhealthy eating, physical inactivity, usage of tobacco products and abusing alcohol are the risk factors for heart diseases. Certain dietary components may help prevent CVDs by assisting the body homeostasis mechanisms. Mango (*Mangifera indica*), is recognized as the "king of fruits" has high nutritious and medicinal value. Pulp, peel, and kernel make up its three basic components. Mango pulp is rich source of amino acids, reducing sugars, aromatic compounds, pectin, vitamins, minerals, polyphenols, and anthocyanins. Mango byproducts (peel and kernel) also have nutritional benefits. Anti-diabetic, anti-inflammatory, anti-oxidant, and anti-carcinogenic compounds are found in mango peel such as mangiferin, protocatechuic acids, vitamins and minerals. Mango kernel has higher levels of antioxidant and polyphenol than the pulp and peel. This review examines the effectiveness of mango pulp, peel and kernel on hyperlipidemia and identifies key bioactive compounds contributing to these effects, highlighting their potential use in natural remedies and as functional food ingredients for managing elevated levels of cholesterol.
Keywords: Hypolipidemic activity**,** mango byproducts, antioxidants, health benefits.

INTRODUCTION

The blood in human body contains cholesterol, which resembles a waxy patch. While cholesterol is necessary for the body to generate healthy cells, having too much of it can increase the risk of developing heart problems. If the cholesterol is excessive, it can develop fat deposits in blood vessels. The volume of blood that may move through roads is gradually reduced by these deposits. Occasionally, these deposits might suddenly split and forming a clot that may lead to a heart attack or stroke (Lawes et al., 2004).

Lipoproteins are molecules made up of protein and fats. They carry cholesterol through bloodstream to cells. Individuals with hypercholesterolemia exhibit elevated levels of low-density lipoprotein (LDL) in their blood. Many people can address it by changing diets and adding exercise to daily routines. Others use drugs to bring their LDL levels back into normal ranges. These treatments lower your risk of heart attack and stroke (Radaelli et al., 2018).

Cardiovascular disease which is caused by atherosclerosis has increased the rate of morbidity and mortality all over the world (Herrington et al., 2016). In past few years, epidemiological, clinical and experimental studies have depicted that in the prevention of atherosclerosis diet plays important role (Barquera et al., 2015).

One study indicates that 73.5 million adults or 31.7% people in the US have high levels of bad cholesterol contribute to increased prevalence of heart issues. Only 48.1% of people receive treatment to lower their LDL levels (Rawshani et al., 2018). According to reports, Punjab has Pakistan's highest prevalence of hypercholesterolemia (41.6%) and Balochistan has the lowest prevalence (22.7%) (Basit et al., 2020). Certain dietary components may help prevent CVDs by assisting the body homeostasis mechanisms. Mangoes (Mangifera indica) are a powerful natural source of bioactive compounds that may help regulate cholesterol and promote cardiovascular health (Ediriweera et al., 2017). This review explores the potential benefits of mango pulps, peels and kernels in reducing hyperlipidemia, highlighting their nutritional and therapeutic value.

Mango (*Mangifera indica*) is a fruit plant belonging to the Anacardiaceae family that is grown extensively worldwide. The second most popular sultry fruit globally and ranks sixth with regard to its production is the mango fruit. Owing to its

Azhar, M., Batool, A., Farooq, U. Song, W., Jamil, F., & Amjad, A. (2025). Hypolipidemic Effects of Mango (*Mangifera indica*) Pulp, Peel and Kernel: A Review. *Journal of Food Processing and Nutrition Research, 2(1),29-38.*
[Received 10 Feb 2025; Accepted 20 Apr 2025; Published 7 May 2025]
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unique flavor and exquisite taste, mangoes are mainly devoured by people of all ages (Torres-Leon et al., 2016). Mangoes are one of the most popular fruits in Pakistan that are used to make a variety of products like jam, pickles, juice, puree, slices, squash and nectar (Nadeem et al., 2016). The phytocompounds found in mango fruit, such as polyphenols, carotenoids, and vitamins, have a variety of pharmacological characteristics (Pourahmad et al., 2010).

Mangos are rich in phytochemicals, which are responsible for the fruit's unique flavor and color (Grundhofer et al., 2001). Mango's phytochemical constituents, which are primarily phenolic compounds are found in the kernel, leaves, bark and fruit of the plant (Ajila et al., 2007; Dorta et al., 2012). Polyphenolic substances found in mango pulp are quercetin, mangiferin, gallotannins, isoquercetin, gallic acids, glucogallin and ellagic acid (Schieber et al., 2000).

Mango's phytochemicals protect the body from oxidative damage because they have antioxidant qualities. The mango fruit also boasts exceptional flavor, a pleasing aroma, a vibrant color, and delectable taste, in addition to health advantages. Due to the ring structures and hydroxyl groups in phenolic substances, low-density lipoproteins (LDL) are more resistant to oxidation. Additionally, phenolic compounds have significant antioxidant properties that include scavenging singlet oxygen molecules, superoxide anions, and lipid peroxyl radicals as well as stabilizing radicals that are unstable linked to oxidative processes through complexation with the oxidizing species or hydrogenation (Ma et al., 2011). Numerous experts have looked at the pharmacological benefits of the different bioactive components of mango fruit in recent years. Mango byproducts have been shown to be more effective and have less adverse effects when treating many chronic disorders, such as cancer, diabetes, asthma, hypertension, and bleeding in the lungs and intestines. The various parts of the mango exhibit diverse health benefits, including anti-inflammatory, anti-cancer, antioxidant, antibacterial, immunomodulatory, anti-hyperlipidemic, and anti-diabetic properties (Figure 1) (Lebaka et al., 2021).

Mango has three distinct parts: pulp (mesocarp), peel (epicarp) and seed kernel (endocarp) (Figure 2). The amount of waste generated during processing of this tropical fruit, which ranks first in the whole world for its production, is substantial. The peels and seeds, often referred as stones, make up the majority of the waste. According to preliminary investigations, the weight of the kernel ranges from 45 to 75% of the weight of the seed (Muchiri et al., 2012).

Nutritional composition of mango pulp, peel and kernel: The most significant and readily consumable part of the mango is its pulp. Mango pulp, comprising 50-60% percent of the fruit's total weight, is used to make many products such as juice, jam, puree, and nectar. Numerous beneficial and nutritive substances can be found in pulp. Mango pulp is used as a flavoring agent in the dairy and beverage sectors as well as in the creation of baby food (National Mango Database, 2020).

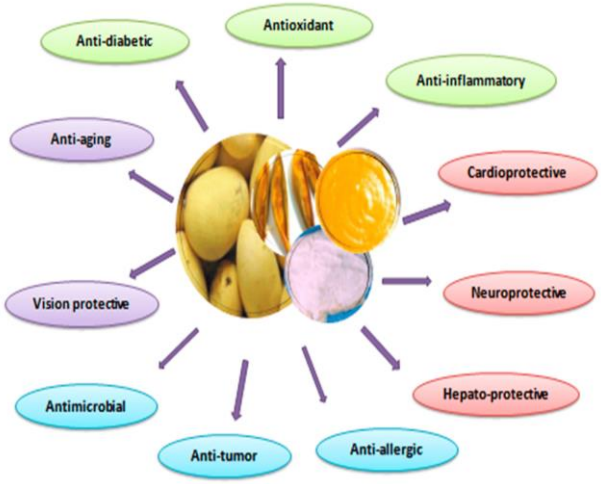

Figure 1. Beneficial health effects of the bioactive substances in mango fruit (Lebaka et al., 2021).

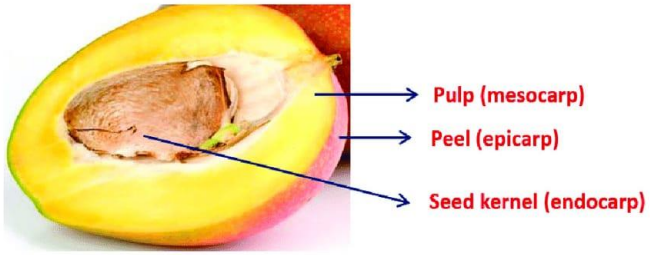

Figure 2. Main components of mango fruit (Muchiri et al., 2012).

The main determining factors of the nutritional composition of mango pulp are the variety of the mango, climatic condition, location of its production zone, and the fruit's maturity (Maldonado Celis et al., 2019). A range of macro- and micronutrients are found in mangoes. Macronutrient composition of mango pulp includes dietary fiber, lipids, proteins, amino acids, carbs and organic acids (Lemmens et al., 2013). The mango pulp contains notable amounts of vitamins and minerals. According to a database maintained by the United States Department of Agriculture (USDA), different kinds of fat and water soluble vitamins are present in mango pulp. As opposed to vitamins E, B and K, vitamins A and C are present in large amounts. A multitude of biological activities require the presence of elemental minerals, which are abundant in mango pulp. Manganese, magnesium, zinc, boron, calcium, sodium, copper, iron, and phosphorus are just a few of the micro- and macro-minerals that are present in mangoes (Table 1) (Tharanathan et al., 2006).

Table 1. Vitamins and minerals composition of mango pulp.

Compound (per 100 g)	Pulp
Folic acid (mcg)	43
Niacin (mg)	0.669
Iron (mg)	40.6
Pantothenic acid (mg)	0.119
Riboflavin (mg)	0.038
Thiamin (mg)	0.028
Vitamin A (IU)	1082
Vitamin C (mg)	36.4
Calcium (mg)	11
Copper (mg)	0.04-0.32
Zinc (mg)	0.09
Magnesium (mg)	10

Mango peel, a valuable byproduct of mango processing, constitutes approximately 15-20% of the fruit's weight. Vitamin E, dietary fiber, vitamin C, polyphenols, and carotenoids are all abundant in mango peel (Ajila et al., 2007). Mango peel contains essential nutrients and nutraceutical substances that can be used to make money in the food sector, reducing and resolving environmental issues. In the past, eastern countries have used mango peels to flavor food, but it would be more cost-effective to use it to make food additives for consumption (Thomas et al., 2013). Vitamins and minerals discovered in mango peel are vitamin C, vitamin A, iron, potassium, magnesium, copper, zinc, calcium and sodium. Mango peel is a good source of nutritional elements than the mango pulp due to its high vitamin and mineral contents (Table 2) (Dar et al., 2016).

Table 2. Vitamins and minerals composition of mango peel (Dar et al., 2016).

Compound (per 100 g)	Peel
Vitamin C (mg)	18-257
Vitamin A (mcg)	100
Iron (mg)	40.6
Potassium (mg)	75
Magnesium (mg)	100
Copper (mg)	10.4
Zinc (mg)	1.74
Calcium (mg)	150
Sodium (mg)	50

Phenolic acid substances discovered in the mango peel are gallic acid, mangiferin, syringic acid, quercetin, protocatechuic and ellagic acid (Ajila et al., 2010). The researchers also found that mango peel contains violaxanthin, carotenoids, lutein, and beta-carotene (John et al., 2002).
Mango seeds are composed of approximately 68% kernel, 3% testicles and 29% endocarp (pit). The skin of the mango seed is often elastic. 77% of the kernel's nutrients are carbs, 6% are proteins, 11% are fats, 2% are ash, and 2% are crude fiber (Diarra et al., 2014). Mango kernels are rich in micronutrients and macronutrients, including potassium, calcium, phosphorus, magnesium, and vitamins A, K, C and E (Mwaurah et al., 2020). Table 3 exhibit the fatty acid profile of MKO. The fatty acid makeup of any oil has a significant impact on its physical and chemical properties. According to the fatty acid composition of mango kernel oil, stearic acid accounted for 37.87 to 39.59% of the concentration of total fatty acid, making it the predominant fatty acid. Other significant fatty acids were 31.51-32.38% omega 9 fatty acid and 15.74-18.88% docosahexaenoic acid. MKO contains linolenic and linoleic acids are recognized as essential acids required for human growth and health (Kostik et al., 2013).

Table 3. Fatty acid composition of mango kernel oil.

Fatty acid	Extract of Soxhlet (%)	Microwave-aided extraction (%)
Stearic	37.87	39.59
Behenic	2.23	Not detected
Lignoceric	0.57	0.60
Palmitic	4.75	4.95
Arachidic	0.46	0.48
TSF	**45.88**	**45.63**
Oleic	31.51	32.38
TMUFA	**31.51**	**32.38**
Docosadienoic acid	Nd	0.08
α-Linolenic	0.37	0.39
Eicosadienoic	Nd	2.32
Linoleic	3.22	3.31
Docosahexaenoic	18.88	15.74
γ-Linolenic	0.14	0.15
TPUFA	**22.61**	**21.99**

Abbreviations: TMUFA stands for total monounsaturated fatty acid; TPUFA stands for total polyunsaturated fatty acid; TSFA stands for total saturated fatty acid.

Polyphenols, vitamin e, and phytosterols are the main biological active substances present in mango kernel. The phytosterols in mango kernels contain phylloquinone (Soong et al., 2006; Tsiaka et al., 2017). Mango kernel oil contains about 4.36 mg/g db of catechin, 0.52 mg/g db of quercetin, and 12.57 mg/g db of mangiferin which are bioactive substances with a strong activity of antioxidants. A diversity of phenolic chemicals with strong antioxidative, nutritional, and medicinal relevance can be found in abundance in mango kernels. The predominant phenolic compounds in mango kernels are mangiferin, gallic acid, quercetin, anthocyanins, catechins, alkylresorcinol, gallotannins, ellagic acid and subtype of benzophenone. These substances have a substantially better solubility in polar solutions because they are hydrophilic. According to the type of extraction and the species of mango used, mango seed kernels contain a total of

18.19-200.35 mg GAE/g db of phenolic acid compounds (Nadeem et al., 2017).

***Hypolipidemic activity of mango pulp*:** Eating 400 g per day of fruits and vegetables is recommended by World Health Organization (WHO) due to the presence of essential fatty acids, vitamins, minerals and dietary fibers that can help prevent chronic diseases such as cancer, diabetes, heart disease, and obesity (WHO, 2003). The use of mangos as functional foods is growing in popularity. Consuming more colorful plant materials may be good for our health because bioactive compounds in mango contribute to their color and potential health benefits. Bioactive compounds, primarily polyphenols present in mango may reduce LDL cholesterol and improve heart health (Bartley et al., 1995).

In the pulp of mango cultivars, homomangiferin, mangiferin, and dimethyl mangiferin were found. Chemically, mangiferin is a yellow like crystal that is a member of the xanthone family. Mangiferin has a lot of health impacts such as anticancer, anti-atherosclerosis, anti-allergenic, anti-inflammatory, antibacterial, analgesic, and immunomodulatory effects. The bioactive compounds like flavonoids, mangiferin, phenolic acids, dietary fibers and vitamin C found in the various parts of the mango are responsible for pharmacological benefits (Ramirez et al., 2013).

In Triton-induced hyperlipidemic rats, mangifera haden, mangifera pirie, and their combined extracts were given at different doses (200 mg, 300 mg, and 500 mg) per kg body weight, the levels of VLDL-C, blood total cholesterol, LDL-C, and the Atherogenic index (A.I.) significantly decrease while serum HDL-C significantly increases. Additionally, the results indicate that mangifera haden and mangifera pirie, at concentrations of 200 mg/kg and 300 mg/kg body weight, is an excellent lipid-lowering agent. Hyperlipidemia was more successfully suppressed by a single dose of Mangifera haden or Mangifera pirie than by a combination of extracts (Nwafor et al., 2023).

Rats fed with normal mango or sapota juices showed an increase in HDL cholesterol levels, while the rats fed with probioticated mango or sapota fruit juices showed a notable decrease in elevated blood lipid profiles such as total cholesterol, TAG, LDL, and VLDL. The outcomes demonstrated that probiotic-infused juices reduced hyperlipidemia more effectively than regular juices due to presence of beneficial bacteria "*Lactobacillus plantarum* (Bathal et al., 2016).

In another study, particulate mango pulp and soluble pectin having high level of dietary fiber, polyphenols and antioxidants were given to pigs for 28 days. Mango pulp (insoluble) and soluble pectin lower plasma bad cholesterol (LDL-C and TC). On the other hand, mango pulp raised plasma triglycerides while soluble pectin markedly reduced plasma triglycerides. The substantial rise in intestinal BA levels observed with pectin diets but not with mango diets (Gunness et al., 2021). 0.7 to 3.9 mg of omega-3 and omega-6 fatty acids and 9.5 to 38.2 mg of phytosterols (glycosylated and free) present in 100 g of mango fruit might greatly improve human health (Vilela et al., 2013).

The study found that fresh mangoes were a healthier substitute for the LFC snack that enhanced antioxidant status, improved blood glucose and cholesterol levels and reduced inflammation as compared to isocaloric low fat cookies. Mangoes have the potential to improve food quality and reduce risk factors associated with obesity due to presence of a variety of bioactive components such as carotenoids, mangiferin and gallic acid (Rosas et al., 2022).

Hypercholesterolemic mice supplemented with microwave-dehydrated mango powder diet showed a notable increase in HDL-C levels, decrease in total serum cholesterol, LDL and VLDL cholesterol levels. The results showed that polyphenols and dietary fiber present in mango pulp have improved lipid profile in mice fed hypercholesterolemic diet (Osorio et al., 2014). Mangiferin supplemented diet were given to diabetic mice while normal mice were fed on basal diet only. The results found that mangiferin reduced blood TG, TC, hyperinsulinemia and blood glucose level in diabetic mice as compared to normal mice. The results suggest that mangiferin might improve lipid profile and diabetes by boosting lipid and glucose metabolism, reducing oxidative stress and increasing insulin sensitivity (Miura et al., 2001). Another study showed that when diabetic rats were treated with mangiferin, it also possesses hypolipidemic and anti-diabetic properties (Muruganandan et al., 2005).

Randomly selected groups of forty male hamsters were placed in three groups: high fat control, normal control and high fat with mangiferin. The use of mangiferin reduced total free fatty acid (FFA) concentrations, hepatic TG levels, serum triglyceride (TG), total cholesterol (TC) and the total free fatty acid contents of the liver, muscles, and body weight, as well as liver and visceral fat. In the liver, mangiferin downregulated the mRNA expression of sterol regulatory element-binding protein 1c (SREBP-1c), acetyl CoA carboxylase (ACC), microsomal triglyceride transfer protein (MTP) and acyl CoA diacylglycerol acyltransferase 2 (DGAT-2) but it upregulated PPAR-a, the mRNA expression of fatty acid translocase (CD36), and carnitine palmitoyl transferase 1 (CPT_2). CD36, PPAR-a, CPT-1, and lipoprotein lipase (LPL) mRNA expression were also stimulated by mangiferin in muscle. Based on the data, it was concluded that mangiferin may reduce higher level of triglyceride by adjusting the levels of genes expression related to lipogenesis and lipid oxidation (Guo et al., 2011).

Hypolipidemic activity of mango peel

Fruit peels (Apricot, plum and mango) are greatest sources of fiber, polyphenols, minerals, flavonoids, and carotenoids which can improve liver, renal function, lipid profiles, and biological parameters. These compounds can inhibit the hypercholesterolemic process. Accordingly, the data

suggested that moderate level of fruit peels powder should be included in our daily diets (Salah et al., 2018).

Rats in experimental groups were given hyperlipidemic diet supplemented with mango peels, apple pomace, and combination of mango peel and apple pomace while rats in the control group were given hyperlipidemic diet alone. Rat groups supplemented with apple pomace and mango peels were reduced high cholesterol levels. Rats which were fed on mango peels supplemented diet was more effective against hyperlipidemia than the powder from apple pomace. In addition to improving the lipid profile, the lipid peroxidation status and liver cholesterol concentration of experimental rats were both better than those of the control group after consuming powdered apple pomace and mango peels. It was concluded that processing waste from mango fruit, particularly mango peels can be used as an affordable management tool for fatty liver diseases, lipid peroxidation, and diet-induced hyperlipidemia (Umbreen et al., 2020).

Soluble and insoluble fiber content in mango peels may directly reduce cholesterol levels because dietary fiber helps to aid in the absorption of bile salts. Additionally, the dietary fiber in mango peels may increase the food's mobility in the digestive system, lowering blood sugar levels and constipation (Sirisakulwat et al., 2008). The study found that consuming mango peel powder resulted in lower levels of urea, bad cholesterol, low-density lipoproteins (LDL), triglycerides and creatinine and higher levels of high-density lipoproteins (HDL) in obese individuals. The results suggesting that vitamin C, vitamin E, polyphenols and carotenoids in mango peels have a potent anti-oxidant and anti-dyslipidemic effects (Arshad et al., 2021).

Ethanolic extract of mango peel and pure mangiferin at doses of 20 and 200 mg/kg body weight were given orally to diabetic rats twice a day for 21 days, respectively. Extract of mango peel extract and mangiferin have significantly reduced VLDL, fasting glucose, LDL and triglyceride levels. Rats showed hypolipidemic, antidiabetic effects, and increased glycogenesis after receiving mango peel extract and mangiferin (Mistry et al., 2023).

Mango and kinnow peel that contains various essential nutrients such as caffeic acid, gallic acid, mangiferin and quercetin were given to hyperlipidemic rats. It was found that mango and kinnow peel extracts at medium and high dose levels improved lactate dehydrogenase, aspartate transaminase, renal function and lipid profile in hyperlipidemic rats. It was concluded that extracts of mango peel and kinnow have the ability to be cardioprotective at high as well as medium dose levels (Safdar et al., 2017).

When streptozotocin-induced diabetic rats were given mango peel powder supplements, their antioxidant enzyme activities were enhanced. This led to improvements in hyperglycemia, hyperlipidemia, and nephroprotective qualities because of presence of dietary fiber and bioactive compounds in mango peel powder. Thus, it was concluded that powdered mango peel may be used as a therapeutic functional food to treat higher blood glucose levels and its related conditions (Gondi et al., 2015).

Hypolipidemic activity of mango kernel: A study was conducted on the antioxidant and tyrosinase inhibitory qualities of extracts of mango seed kernels which are often thrown away after the fruit is processed. The study found that extracts of mango seed kernel have high total phenol content tyrosinase inhibitory, metal-chelating, and radical-scavenging properties. This extract may be suitable to be used in medicinal, nutraceutical, cosmetic and food applications (Maisuthisakul et al., 2009).

Mango seed kernel oil contains gallic acid, which has long been recognized as an anti-inflammatory, anti-mutant, and antioxidative substance. Ellagic acid, which is also found in kernel oil, possesses antimutational, anticarcinogenic, antioxidant, antiviral, and anticancer effects (Soong et al., 2006). Gallic and ellagic acids present in mango kernel have cardioprotective properties and can lower the adverse effects of chemotherapy (Nikbakht et al., 2015).

Mango seed kernel oil's antioxidant qualities are partly attributed to its abundance in mono-saturated, unsaturated fatty acids, tocopherols, sterols, their ester and other phenolic compounds that are found in the oil's non-saponifiable matter (Abdalla et al., 2007).

Mangifera indica kernel flour (MIKF) is a good source of phenolic acids and bioflavonoids, both of which have pharmacological significance. Rats having type 2 diabetes were given 10 percent and 20 percent diets supplemented with MIKF while control rats were only fed on basal diet for 21 days. The lipid profile, pancreatic malonaldehyde, hepatic glycogen, liver function markers, fasting blood glucose, glycosylated hemoglobin, plasma electrolytes, and hepatic malonaldehyde improved significantly when the MIKF-supplemented diets were consumed by diabetic rats as compared to control group (Irondi et al., 2016).

MKO is suitable for consumption without additional processing because of its oxidizing properties and non-esterified fatty acid content. Mango kernel oil contains essential fatty acids and doesn't contain trans fatty acids, which is very beneficial for ischemic heart disease (Jahurul et al., 2015).

In a single dose study, dose of *Mangifera indica* seed kernel extracts reduced blood glucose, triglycerides as well as bad cholesterol levels in diabetic rat contrasted with diabetic controls while extract of mango kernel had not shown hypoglycemia activity on normal rats. To identify the mechanism of action present in the mango kernel extracts, more research must be conducted (Basha et al., 2011).

At a concentration of 500 and 1000 ppm, the greatest radical-scavenging behaviour was observed by mango seeds ethanol extract (96.86%) as compared to ascorbic (91.53%) and BHT (94.9%) activity. Synthetic antioxidant BHT is not as effective as the maximum concentration of MSKE (500, 1000

Table 4. Other Health benefits of mango byproducts.

Component /extract type	Dose/type of study	Health benefits	Biological effect	Reference
Mango pulp	400g/day	Antioxidant activity	Prevent chronic diseases such as cancer, diabetes, heart disease and obesity	WHO, 2003
Mango pulp	300mg/kg	Antioxidant activity	LDL, VLDL, total cholesterol, HDL, triglycerides improved	Nwafor et al., 2023
Mango Peel	200mg/kg	Antidiabetic and hypolipidemic activity	Bad cholesterol, LDL, HDL, VLDL blood glucose, urea improved	Mistry et al., 2023
Mango kernel flour	In vivo in animals	Antidiabetic effect	Fasting blood glucose, lipid profile, liver function glycosylated hemoglobin improved by mango kernel flour supplemented diet of diabetic rat	Irondi et al., 2016
Alcoholic Extract from Mango kernel	500mg/kg In vivo in animals	Antidiabetic effect	Blood glucose and insulin levels improved	Petchi et al., 2011
Ethanolic extract from mango kernel	200mg In vivo in animals	Antioxidant activity	Weight gain exhibited by grower pigs	Araujo et al., 2019
Phenolic extract from mango kernel	In vitro	Antiproliferative activity	Colon cancer cells proliferated by mango kernel extract	Ballesteros et al., 2019

ppm) in preventing both primary as well as secondary oxidation of SFO samples during storage. Mango seed kernel extract has demonstrated a high potential for use as a natural antioxidant source (El-Kady et al., 2017).

When broiler chickens fed ethanolic extract of mango kernel for 42 days, no detrimental effects were observed on the production, body characteristics, or relative weight of various digestive tract segments but it lowers total plasma cholesterol, LDL and VLD cholesterol levels (Araujo et al., 2018).

Throughout an eight-week study, different biochemical parameters of metabolic syndrome (glucose, triglycerides, total cholesterol) and body weight were monitored in four different groups of Swiss albino rats: (1) normal diet (ND), (2) high-fat diet (HFD), (3) HFD + MESK (75 µg/kg) and (4) HFD + Orlistat (100 µg/kg). FITC-dextran method was used to measure intestinal permeability. It was stated that mango seed kernel extract (MESK) considerably decreased the body weight gain, dyslipidemia, hyperglycemia, hepatic fibrosis, and hepatic lipid accumulation brought on by HFD. As a nutraceutical, MESK blocks intestinal barrier disruption, preventing the negative effects of impaired intestinal permeability, including obesity, hyperglycemia, dyslipidemia, and systemic inflammation (Mujawdiya et al., *2020*).

Proteins, macromolecular antioxidants with antiseptic potential, vegetable-derived oils (stearic/oleic) are all plentiful in mango kernels. Pectin/cellulose, carotenoids, and phenolic chemicals are the abundant sources of mango peels and seeds that have health advantages for type 2 diabetes, coronary artery disease, cancer, and the metabolic disorder. It has been demonstrated that oleic acid in mango kernels may reduce atherosclerosis (Wall et al., 2020).

***Conclusion*:** It has been established by previous research that mango byproducts (peel, pulp, and kernel) are great source of microelements, minerals, dietary fiber, vitamins, and polyphenols, among other biological active substances. These substances help protect the body from the harmful effects of reactive oxygen species, which can cause chronic conditions like diabetes, atherosclerosis, cancer, and cardiovascular illnesses. This is because they have strong antioxidant properties. In order to determine the toxicity or the appropriate dosage of these substances, further pharmacodynamics, pharmacokinetic and clinical trial research is required. The studies revealed that regular use of mango fruit and its byproducts could improve general health as mango byproducts are thought to be harmless and even advantageous for heart due to cholesterol-lowering properties.

***Future perspectives*:** The huge amount of waste generated by food processing sectors could have been used to create innovative products. Studies on hypolipidemic potential of mango byproducts indicate prospects for future use in the management of lipid illnesses and improvement of heart health. Further research might discover innovative therapeutic approaches for the management of dyslipidemia and other chronic diseases by examining bioactive compounds in mango byproducts. Comprehending general health consequences may provide an important insight of health advantages of integrating products obtained from mango into diets.

***Acknowledgement*:** The authors acknowledge the support of the Faculty of Food and Home Sciences, Muhammad Nawaz Sharif University of Agriculture, Multan, Pakistan, and Zhengzhou Research Institute, Harbin Institute of Technology, China, for providing academic guidance and access to scientific resources during the preparation of this review.

***CRediT author statement*:** Muneeba Azhar: Conceptualization, literature review, writing - original draft. Aliza Batool: Data curation, methodology, writing - review & editing. Umar Farooq: Visualization, technical input, content refinement. Wei Song: Validation, supervision, scientific guidance. Fareena Jamil: Literature retrieval, proofing, reference management. Aqsa Amjad: Figure/table formatting, editing, final manuscript polishing.

***Conflict of interest*:** The authors declare no conflict of interest.

***Ethical statement*:** Ethical approval was not required for this review article because it does not involve experiments on animals or humans.

***Availability of data*:** All data presented in this review are derived from previously published literature and referenced sources. Additional supporting information can be provided upon reasonable request.

***Consent to participate*:** Not applicable, as the study did not involve human or animal subjects.

***Informed consent*:** Not applicable.

***Consent for publication*:** All authors have read, approved, and consent to the publication of this manuscript.

***SDGs addressed*:** Good Health and Well-being; Responsible Consumption and Production; Climate Action.

***Policy referred*:** World Health Organization (WHO) dietary guidelines related to fruit and vegetable intake to reduce the risk of non-communicable diseases.

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